THE CRUSHED STONE JOURNAL

Official Publication
The National Crushed Stone Association

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FEBRUARY, 1930

WHY HAVE LOSSES

Poor Grading—High Overhead—Troubles

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Solvay Process Company	Jamesville, N. Y.
Solvay Process Company	Syracuse, N. Y.
Rock-Cut Stone Company	Auburn, N. Y.
Rock-Cut Stone Company	Ballina, Madison Co., N. Y.
Rock-Cut Stone Company	Jamesville, N. Y.
Rock-Cut Stone Company	Lacona, N. Y.
Rock-Cut Stone Company	Watertown, N. Y.
Mohawk Limestone Products Company	Mohawk, N. Y.
Mohawk Limestone Products Company	Jordanville, N. Y.
Mohawk Limestone Products Company	Mount Vision, N. Y.
BUFFALO Crushed Stone Company	Buffalo, N. Y.
Federal Crushed Stone Company	Cheektowaga, N. Y.
Genesee Stone Products Company	Stafford, N. Y.
LeRoy Lime and Crushed Stone Company	LeRoy, N. Y.
Ribstone Concrete Products	LeRoy, N. Y.
Dolomite Products Company	Rochester, N. Y.
General Crushed Stone Company	Oaks Corners, N. Y.
General Crushed Stone Company	North LeRoy, N. Y.
General Crushed Stone Company	Glenmills, Penna.
Wagner Quarries	Sandusky, Ohio
Wagner Quarries	Castalia, Ohio
Dolomite, Inc.	Maple Grove, Ohio
Herzog and Sons	Forest, Ohio
Ohio Blue Limestone	Marion, Ohio
National Lime & Stone Co.	Spore, Ohio
National Lime & Stone Co.	Carey, Ohio
National Lime & Stone Co.	Lewisburg, Ohio
National Lime & Stone Co.	Bluffton, Ohio
Belle Center Stone Co.	Belle Center, Ohio
Higgins Stone Company	Bellevue, Ohio
Lake Erie Limestone Company	Youngstown, Ohio
Lake Erie Limestone Company	Lowellville, Ohio
Lake Erie Limestone Company	Hillsville, Pa.
Lima Stone Company	Lima, Ohio
Spencer Stone Company	Spencerville, Ohio
Union Limestone Company	Youngstown, Ohio
Ohio Marble Company	Piqua, Ohio
C. C. Beam	Melvin, Ohio
Rock Products Company	Toledo, Ohio
France Stone Company	Holland, Ohio
France Stone Company	Monroe, Mich.
Swint Stone Company	Fremont, Ohio
J. E. Baker Company	Bainbridge, Lancaster Co., Pa.
J. E. Baker Company	White Hall, Baltimore, Md.
New Castle Lime & Stone Company	New Castle, Pa.
New Castle Lime & Stone Company	Dunbar, Pa.
Lehigh Stone Company	Ormrod, Pa.
Stowe Trap Rock Company	Pottstown, Pa.
Carbon Limestone Company	Hillsville, Pa.
Blue Stone Quarry Company	Gwynedd Valley, Pa.
Whiterock Quarries	Pleasant Gap, Pa.
Connecticut Quarries Company	Rocky Hill, Conn.
New Haven Trap Rock Company	New Haven, Conn.
Edward Balf Company	Hartford, Conn.
John S. Lane and Son	Westfield, Mass.
West Roxbury Trap Rock Company	West Roxbury, Mass.
Old Colony Crushed Stone Company	Quincy, Mass.
Rowe Contracting Company	Malden, Mass.
Simbrico Stone Company	West Roxbury, Mass.
Casper Stolle Quarry & Construction Co.	East St. Louis, Ill.
Consumers Company	Lemont, Ill.
Federal Stone Company	LaGrange, Ill.
Michigan Limestone & Chemical Company	Rogers City, Michigan
Biesanz Stone Company	Winona, Minn.
Meshberger Bros. Stone Company	Berne, Ind.
Hy-Rock Products Company	Marengo, Ind.
Fanwood Stone Crushing & Quarry Co.	Fanwood, N. J.
Samuel Braen	Patterson, N. J.
Orange Quarry Company	West Orange, N. J.
Granite Rock Company	Logan, Calif.
Daniel Contracting Company	San Francisco, Calif.
Deitz Hill Development Company	Kansas City, Mo.
Rock Hill Quarries Company	St. Louis, Mo.
Texas Trap Rock Company	San Antonio, Texas
Dittlinger Lime Company	New Braunfels, Texas
James Stone Company	Corsicana, Texas
Franklin Limestone Company	Nashville, Tenn.
Gager Lime Company	Sherwood, Tenn.
John H. Wilson	Honolulu, Hawaii

CANADA

J. A. Bourbonnais	Vaudreuil, Que.
Canada Crushed Stone Corp.	Puslinch, Ont.
Coast Quarries	Vancouver, B. C.
Dufferin Construction Company	Innerkip, Ont.
Gordon Crushed Stone Company	Hagersville, Ont.
Thomas Langton Crushed Stone	Coldwater, Ont.
LaCle A. Desrosiers, Ltd.	Montreal, Que.
Puslinch Quarries, Ltd.	Puslinch, Ont.
Quinn Stone and Ore Company	Ft. William, Ont.
Rigand Granite Products Company	Rigand, Que.
Stone and Son	Ingersoll, Ont.
Standard Lime Company, Ltd.	Joliette, Que.
Walker Bros.	Thorold, Ont.
Warden King Company, Ltd.	Montreal, Que.

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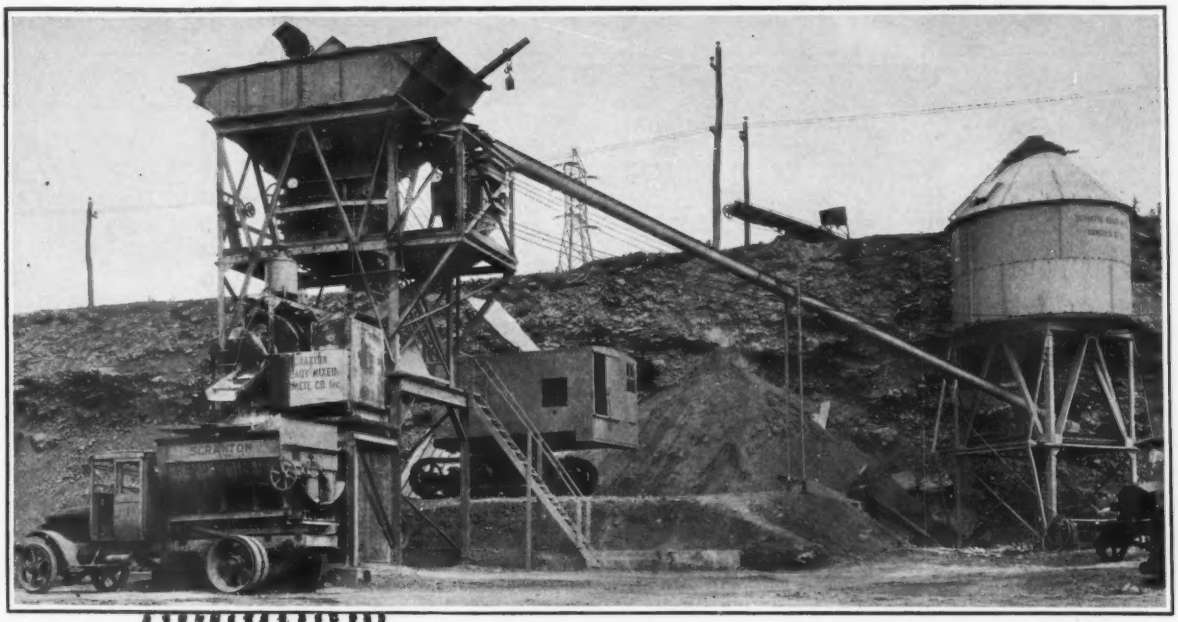

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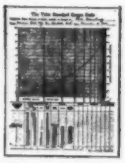

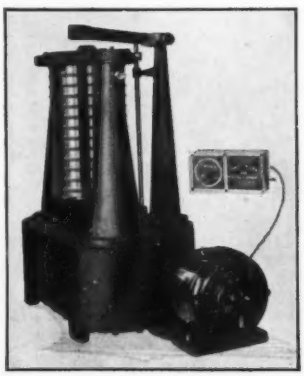

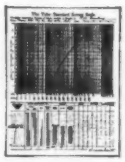

RO-TAP TESTING SIEVE SHAKER

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Manufacturers' Division Exposition Creates Unusual Interest

H. M. Davison is Newly Elected Chairman

FROM its formal opening at 7.30 p. m. Monday evening, heralded by a brief but entertaining program rendered in the main lobby of the Hotel Gibson by a trio of strolling musicians (who subsequently concluded their performance in the Exposition Hall), until its close at 6.00 p. m. Wednesday, the Manufacturers' Division Exposition of Quarry Equipment and Machinery vied with other features of the annual convention of the crushed stone industry recently held at the Hotel Gibson, Cincinnati, for the center of interest; and we believe came out overwhelmingly the victor. Such must be one's conclusion as evidenced by the large number of delegates who seized upon every available opportunity to visit the Exposition Hall and who indicated by their enthusiastic comments, their appreciation of the various exhibits.

This widespread approval of the Exposition was justly deserved: more than at any previous convention, there was an unmistakable trend on the part of the individual exhibitors to make their displays not only attention arresting but at the same time interesting, instructive and educational; the number of companies exhibiting and the total number of booths occupied showed a most gratifying increase and in this connection it is particularly striking to remember that when the convention was last held in Cincinnati in 1925, the second year of the Exposition, it was participated in by 47 companies, occupying 57 booths, as compared to 67 companies occupying 96 booths when we returned to that city after a lapse of but five years; the Main Ballroom of the Hotel Gibson provided a most attractive setting for the Exposition, it being possible to place all of the exhibits in the one room, an arrangement much to be desired.

The Manufacturers' Division Exposition is for the purpose of bringing before the crushed stone industry the latest improvements and developments in the machinery, equipment and supplies used by the industry, and as such it fulfills a very definite function which can be most effectively accomplished at no better time than at the annual meeting. At that time there are gathered together from all parts of the United States and Canada the foremost producers of the industry, including not only executives but each year an increasingly large number of superintendents and operating men. To the latter, the Exposition particularly appeals as it gives them an opportunity of visually inspecting such developments as are of especial interest.

A more recent trend and one which deserves our enthusiastic encouragement is the tendency for exhibiting companies to have present at their booths technical representatives—men qualified to discuss from the engineering or econmic point of view the many problems which are constantly perplexing the producer. We cannot too heartily commend this desire on the part of the exhibitors to render a still more useful service and it is hoped that the number of manufacturers who have their technical representatives at the Exposition will be increased each year.

Somewhat of an innovation was introduced at the Convention this year which had as its object the stimulation of a greater interest in the Exposition on the part of the delegates in attendance. This took the form of a contest, sponsored by the Association, for its active members. Briefly, the contest was as follows: each exhibitor was provided with stickers bearing his particular identification number; each active member was given a card upon which there was a square corresponding to each exhibitor's number; the object was to completely fill the card with the proper stickers, which could only be done by obtaining them from the respective booths; those active members who were successful in completing cards had their names placed in a bowl and the first ten drawn were each

H. M. DAVISON

Harnischfeger Sales Corporation, Elected Chairman of the Manufacturers' Division

awarded a beautiful and appropriate prize. Through this means attendance at the booths was markedly stimulated and the idea met with such popular approval, from both active members and exhibitors, that in all probability similar contests will be held at future conventions.

As a part of this contest a competition was also held between exhibitors for the most interesting exhibit, the judges being the active members themselves who participated in the contest, each active member indicating on his card the three exhibits which appealed to him as being the most interesting. The vote as between the General Electric Company's exhibit and the joint exhibit of the Bucyrus-Erie Company and the Woodward Engineering Company was exceedingly close, the former winning by a narrow margin. Third place was taken by the Mack-International Motor Truck Corporation. The winner was given a beautiful silver loving cup suitably inscribed, while honorable mention was awarded second and third places.

In order to stimulate a desire on the part of the exhibitors to display exhibits particularly applicable to the respective products manufactured and designed to be not only interesting but instructive and educational, a contest of similar nature will be held at next year's convention. Complete details will be provided exhibitors well in advance of the meeting.

Manufacturers' Division Holds Annual Meeting

The annual business meeting of the Manufacturers' Division was held during the convention on Tuesday evening, January 21, at the Hotel Gibson, with an unusually large number of representatives present. The manufacturers were assembled for dinner at 6.00 p. m., immediately following which the meeting was called to order by Chairman Lewis.

In opening the meeting Mr. Lewis took occasion to express his grateful appreciation for the loyal support and helpful cooperation which had been extended to him throughout the year. He also stated that in his opinion the membership quota of the Division, of one hundred firms, would be completed within a few months. It seems appropriate to mention at this time that the very substantial gain in the membership of the Division during 1929 was due in large part to the enthusiastic and untiring efforts of Mr. Lewis and his vice-chairmen and they are to be congratulated upon the success of their efforts.

E. G. Lewis
Retiring Chairman of the Manufacturers' Division

The following resolution was passed as an expression of appreciation to Mr. Lewis for his conscientious service to the Division during the past year:

> *Resolved*, That the Manufacturers' Division of the National Crushed Stone Association, in annual meeting assembled, does hereby express its sincere and hearty appreciation of the able and helpful work done in its behalf by our retiring chairman, Mr. E. G. Lewis, and the Secretary is hereby instructed to record this resolution in full upon the minutes of this meeting and to send to Mr. Lewis a written copy thereof.

Feeling that some provision should be made for transacting the business of the Division which might come up between annual meetings, the following

B. G. SHOTTON,
Hendrick Manufacturing Co., elected to represent Manufacturers' Division on National Board of Directors

amendment to the By-Laws was unanimously approved:

Resolved, That the By-Laws of the Manufacturers' Division of the National Crushed Stone Association be hereby amended by the addition of Article 7 which shall read as follows:

Article 7. During the period between successive annual meetings of this Division, an Executive Committee consisting of the Chairman, Vice-Chairmen and Secretary shall have full power and authority to act in the capacity of the Division as a whole in deciding any questions of importance or policy as occasion may demand.

The report of the Nominating Committee was unanimously approved which resulted in the election of the following officers for the ensuing year:

CHAIRMAN:

H. M. Davison, Harnischfeger Corporation, Milwaukee, Wisconsin.

VICE-CHAIRMEN:

M. S. Lambert, Robins Conveying Belt Co., Chicago, Illinois.

Thos. MacLachlan, Vulcan Iron Works, New York City.

L. W. Shugg, General Electric Co., Schenectady, N. Y.

A. E. Reed, The W. S. Tyler Co., Cleveland, Ohio.

H. C. Ryder, The Hayward Co., New York City.

REPRESENTING THE DIVISION ON THE NATIONAL BOARD:
B. G. Shotton, Hendrick Mfg. Co., Pittsburgh, Pa.

With characteristic wisdom and forethought, the Division, in electing H. M. Davison as its new chairman, has selected one who is unusually well fitted to undertake the responsibilities of this office. That he does not assume them lightly was clearly indicated in his brief, but earnest and sincere remarks of acceptance. Under his capable direction, the Division should prove an even greater instrument of service to the crushed stone industry.

Prize Award for the Most Interesting Exhibit

One Year Tests on the Effect of Dust Coated Stone on the Properties of Concrete

By A. T. Goldbeck

Director, Bureau of Engineering, National Crushed Stone Association

In the January-February, 1929, issue of *The Crushed Stone Journal* were published the results of tests to determine the effect of dust-coated stone on the properties of concrete. In these tests three different types of coarse aggregate were employed, a limestone, a trap rock and a sample of gneiss. Concrete beams and cylinders were made in proportions of 1:2:3 by loose volume and the coarse aggregate was previously dampened and thoroughly mixed with given percentages of fine stone dust made of the stone used in the tests so that the coarse aggregate was thoroughly coated with a pasty coating before it was made up into concrete.

The strength tests were made at 28 days and also a series of wear tests were made on the troweled surface of the concrete to determine if the dust had a tendency to create a weak surface layer which might wear rapidly. The indications from these preliminary tests as stated in the above-mentioned article were as follows:

1. That a decrease in modulus of rupture due to the dust is from 1 to 1½ per cent for each increase of 1 per cent in dust (percentage based on weight of stone).
2. That a decrease in crushing strength is from 0 to 2 per cent for each increase of 1 per cent in dust up to a limit of 5.7 per cent of dust used in these tests.

The wear tests resulted in the general conclusion that dust up to 5.7 per cent by weight of stone did not cause any serious decrease in resistance to wear.

The 28-day tests, therefore, showed that the dust coated stone of the varieties used did not have any particularly bad effect on the properties of concrete, even when the dust extended up to 5.7 per cent of the weight of the stone. Ordinarily a commercially produced stone which is badly coated will not have more than 1¼ per cent of dust by weight, provided the dust is uniformly distributed throughout the mass. Of course, there is, the possibility of a higher percentage of dust accumulating in layers, especially after a heavy rain.

The question natural arises as to whether the dust may not cause trouble at longer periods even though no bad effects are noticed at the age of 28 days. To investigate this possibility, concrete specimens were made up for testing at the age of one year. As in the case of the 28-day specimens, the stone was previously coated with dust by mixing the moist stone with the dust. In the present series limestone only was used, having the following gradation:

1-½ inch .....60 per cent
½-No. 4 mesh .....35 per cent
No. 4-0 ..... 5 per cent

The proportions were 1:2:3 by loose volume. The sand was Potomac river sand having the following gradations:

Potomac River Sand Gradation

	Per cent
Total retained on No. 4	3
" " " " 10	19
" " " " 20	31
" " " " 30	41
" " " " 50	75
" " " " 100	93
" " " " 200	96
Silt and clay	2.7

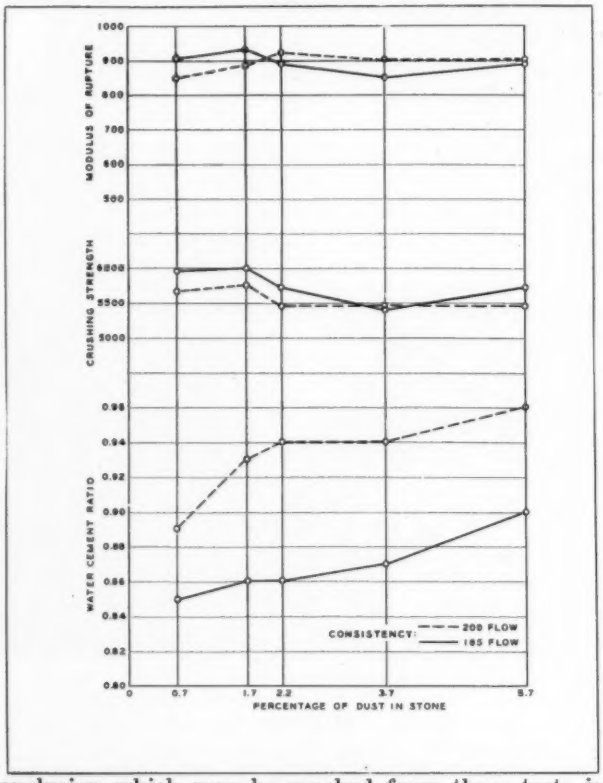
In the following table are given further data with regard to the concrete:

Data on Concrete Mixtures Used to Determine Effect of Dust-Coated Stone on the Strength of Concrete at Age of One Year

Spec. No.	Dust %	Flow	W/C	Wt. per Cu. Ft.
18A2	0.7	194	.89	147.8
18B2	1.7	200	.93	149.6
18C2	2.2	198	.94	148.2
18D2	3.7	197	.94	148.2
18E2	5.7	198	.96	148.6
18F2	0.7	162	.85	148.8
18G2	1.7	166	.86	148.8
18H2	2.2	162	.86	148.4
18I2	3.7	160	.87	148.2
18K2	5.7	163	.90	148.8

The accompanying figure gives the strength results obtained with concrete of medium and also of comparatively wet consistency. Referring to this figure, it will be noted that as the percentage of dust increased, it was necessary to somewhat increase the water cement ratio in order to maintain the desired consistency. Notwithstanding this fact, however, there seems to be no marked decrease in strength either in compression or cross-bending. The compressive strength seems to be slightly more affected than the

affect the design of concrete structures. The general cross-bending strength. In any event, the decrease in strength is not of sufficient magnitude to in any way



conclusion which may be reached from these tests is that stone dust up to 5.7 per cent of the weight of stone used does not seem to have any particular effect on the properties of the concrete.

It should not be concluded, as the result of these tests, that in no case does stone dust produce harmful results in concrete. There are well authenticated cases of dust interfering with the bond between the coarse aggregate and the mortar. Evidently there are certain types of stones to which the dust clings tenaciously, notwithstanding the scouring action which takes place in the mixing process.

Other stones, such as typified by that used in the present tests, are scoured during the mixing of the concrete and no bad effects are produced. Stones of this character, containing coatings composed of rock dust alone which is easily displaced, probably are never harmful. Other stones from which the dust coating is not easily removed may produce bad effects. Each case is an individual one which should be judged on its merits.

New Record Established for Public Construction

CONTRACTS awarded in 37 States during January for the construction of public works and public utilities valued at $112,065,200—an increase of 116 per cent over December—established a January record for six years, the Secretary of Commerce, Robert P. Lamont, announced February 18 on the basis of statistics obtained from private and official sources. The full text of the announcement, made public by the Department of Commerce, follows:

According to the records of the F. W. Dodge Corporation of New York, construction contracts for public works and utilities in January, 1929, covering 37 States, were valued at $66,522,000 against $72,039,000 for January, 1928; $58,955,000 for January, 1927; $52,922,000 for January, 1926; and $37,669,000 for January, 1925.

Prior to 1925 the most comprehensive figures available covered a smaller number of States.

Contracts for public works and utilities awarded in 37 States during last December were valued at $51,820,000 against $72,361,000 in November, and $85,116,000 in October. During July, 1929, when all monthly records for peace time were broken, public works and utilities construction reached the total of $194,547,000.

Contracts awarded for all classes of construction during January, 1930, were also above the December total, being $323,975,200, and $316,368,100, respectively. During January, 1929, awards for all classes reached $409,967,900.

In the field of private construction "commercial buildings" registered an increase of about 62 per cent in January over December, the figures being $33,392,100 for December and $54,052,300 for January. Offices and storage account for about 60 per cent of the construction in this field; an increase of slightly over 10 per cent was recorded in contracts awarded for hospitals and institutions; and 14.9 per cent in construction for social and recreational purposes.

Railroad construction, highways, bridges, and sewage systems in cities were the leaders of the field on public works and utilities.

Contracts awarded for industrial plants and for residential dwellings declined substantially in January as compared with December.

Accident Prevention in the Crushed Stone Industry

ACCURATE, complete and properly segregated records for the crushed stone industry proper are not available. Enough figures are at hand, however, to indicate that:

a. The accident rate for the quarry industry is higher than that of the crushed stone portion of it.
b. The accident rate of the quarry end of the cement industry has been brought down far below the average of the quarrying industry.
c. A few members of the crushed stone industry who are doing excellent accident prevention work have brought their accident rate down to a fraction of that of the industry as a whole.

That the annual total of on the order of 150 deaths and 15,000 lost time accidents is a heavy tax on the industry is obvious. The indirect cost is still larger even though probably few realize it. This paper will attempt to show what some of these costs are and how they are to be saved through preventing accidents.

Direct Savings Possible

It is safe, in fact, conservative to say that the average member of the crushed stone industry can save at least half his direct accident cost. By direct cost we mean compensation and medical. And, of course, cutting the direct cost in half can sooner or later be translated into lower insurance costs either by self-insurance or by lower charges for insurance. Records available of the work of members of the industry prove this. A couple of instances will, we believe, be enough to prove the point.

The General Crushed Stone Company with ten quarries in four states saved approximately half its insurance bill through self-insurance combined with better accident prevention work. Its saving in the year 1928 over 1927 was on the order of $2500 per quarry on the average. Its 1929 record is even better.

The Baker Company with six quarries reduced in a year of effort its accidents involving lost time by some 80%. Its previous record was probably not up to the average of the industry but neither was it the worst in the industry. And there is every evidence that the improvement will be maintained. Obviously such an improvement should show financial benefits even greater in proportion than in the case of the General Crushed Stone Company.

These are both large companies but their quarries range from small to large. What they are doing with all their quarries is just as easy to do with a single quarry or a couple of quarries large or small.

Indirect Savings and Profits

Mr. O. M. Graves, Vice President of the General Crushed Stone Company, says: "Large as our direct savings have been in reducing accidents, the benefits incidental thereto have been greater. The spirit of teamwork and cooperation through the whole organization has been improved, properties are kept cleaner, more attention is being paid to economy of operation, the work gets better planning and execution, and the standards of performance everywhere have been set higher."

Statements along similar lines are to be had for the asking from every executive in the industry whose organization has made important reductions in its accident record over a long enough period to be conclusive. The story is similar in every industry. To those of us who work somewhat as missionaries trying to persuade the insufficiently convinced "to go out and do likewise," it is astounding that so many are so blind. Everyone who goes after accident prevention with sufficient vigor and intelligence to achieve a good record desires passionately to maintain it. He is never willing to drop back. In fact, if through misfortune he does drop back for a while, he, figuratively speaking, weeps and tears his hair. Surely then, but safety road is a good road for everyone to travel, but it is often very hard to convince even those who would gain the most from effective accident prevention work.

Consider a typical quarry accident. A rock falls from the face and hits a man. Everything stops while he is rescued, given first aid and rushed to the hospital. If he is pretty much hurt, a large part or perhaps all of that day's production will be lost, while the accident is being discussed, while the face is being inspected, and while the hurt worker is being replaced. And if the injured man is an important, well-liked employe, or if the details of his suffering are particularly harrowing, it may be many days before the working

force settles back to normal efficient operation. Such indirect costs may obviously be very large.

It is gradually being realized that important incidental benefits flow from accident elimination. In fact, these benefits may be more important than all the direct and indirect economies referred to above. These benefits cannot be accurately measured by any definite standard, but they exist and may be very large indeed. These are what Mr. Graves had in mind when he spoke of improved teamwork, more economical operation and higher standards of performance.

The overwhelming majority of accidents occur because something didn't go as planned, or some unit, human or mechanical, failed to function properly. Therefore, the way to eliminate accidents is to study every bit of every kind of work done to find the best, least hazardous way, make sure that all equipment is proper for the purpose and kept in the proper condition, and to organize and train the personnel so that each individual functions efficiently as a unit in the team. In other words, accident prevention must be seen as an intimate part of every day successful operation. Any such analysis and tuning up of equipment, working methods and personnel as is necessary to reduce accidents to the minimum must of necessity discover hitherto hidden opportunities for improvements and economies. Accident prevention may be largely a by-product of economical operation or it may be the other way around, but the two things go together—they cannot be divorced. A plant, any plant in any industry with a high accident rate will have high costs. It cannot be otherwise.

How to Prevent Accidents

Undoubtedly the first requisite is that the management wants accident-free operation enough to insist on getting it. Exactly the same attitude must be taken as would be the case with any other major activity. As long as the management continues to regard accident prevention as a side issue of little relative importance, the organization as a whole will take the same view and accidents will continue. But when the word goes out that the "Old Man" wants safety bad enough to be really determined to get it, every employe from the highest to the lowest will begin to take an interest and cooperate toward the desired end.

The entire staff must cooperate wholeheartedly. If individual members understand, they will cooperate. It is not too much to say that any foreman or staff executive who cannot with reasonable effort be brought to believe in safety and to cooperate effectively is unfit to direct others and unfit for his job.

With the staff understanding and pushing hard for accident elimination, the interest of each employe can be readily enlisted. Men once convinced that the company really wants the safest possible operation will go along with any reasonable program whatever. In fact, the story of the safety movement is full of instances where the enthusiasm of the men for safety has risen to very splendid heights.

It is not enough that men obey orders and observe precautions intended to keep them from injury. Each man should himself practice safety, think about it, and train himself in working in a safe manner. He will eventually acquire a skill in working safely that is just as definite a thing as skill in doing any special work easily and well. And the worker who is skilled in working safely will do better work and accomplish more because of this skill.

Every operation carried on should be analyzed to discover hazards and reduce them to the minimum practical degree. While the management must take the initiative in this, a very large volume of good ideas can be had from the men. The sum total of a large number of improvements and better ways of doing that can come from an interested working force can be vastly more worth while than any betterments the management will think of and put into effect.

Other than routine operations, particularly such extra hazardous work as heavy repair or construction, should be planned in advance with the greatest care. Makeshift plans often succeed brilliantly, but more often they don't. The wise, careful, and experienced executive leaves as little as possible to decision on the job.

The physical condition of employes is more important than many realize. A very considerable number of rather common ailments exist that increase the chances of injury or are likely to aggravate or be aggravated by an injury. Of these probably hernia is the most troublesome, but heart trouble, epilepsy, syphilis, tuberculosis, and varicose veins are not uncommon. Hearing and eyesight are of obvious importance. It is important to have physical examinations of all new employes. Also it is usually possible to arrange for at least an annual examination of all employes, and while this should not be compulsory, if the matter is handled right, few employes will object. It must be done from the standpoint of helping the employe cure any existing troubles. No employe

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Airport Paving[1]

BY R. H. SIMPSON,
Chief Engineer, Department of Public Works, Columbus, Ohio

AIR transportation has had a remarkable development in the United States during the past few years. Since Lindbergh's flight to Paris, millions have become interested in aviation. Almost over night we have become an air-minded nation. Within recent months many new air lines have been established, including two combination air-rail routes across the continent. With this tremendous increase of public interest, the ground facilities have not kept pace with other branches of aeronautics. It is true there has been a large increase in the number of airport sites and landing fields established. The report of the Department of Commerce shows 1520 airports in operation in the United States, on October 2nd, 1929, but at most of these sites there have been no expenditures for improvement except perhaps for a hangar and beacon. One can count on the fingers of two hands the airports in the United States, on which improvements such as sub-drainage, paved runways and lighting, have been installed.

A prominent government official is quoted as saying, recently, that the crying need for aviation today is one hundred properly equipped airports located at stragetic points. By "properly equipped" he no doubt means well lighted and well drained fields, with paved take-off and landing areas, so that they may be used at all times and under adverse weather conditions. With the tremendous increase in air mail service and with passenger transport ships now flying on schedule, a point has been reached where delays to the departure of ships or the inability to land, because of field conditions, is intolerable.

Just a few days ago, one of the air lines in the mid-west territory could not start a plane from the terminal because some of the other fields on its route were so badly water-soaked as to make landing unsafe. It is evident, therefore, that the next few years will witness an extensive development of airports along the lines of drainage, paving and other needed improvements, in order that the ground facilities of aviation may be brought up to the standard of other branches of the industry. The paving of airport runways is the general subject to which I desire to call your attention this morning.

Let us consider some of the requirements for a paved runway. First: It should be of a type that can be built at reasonable cost. The economic factor is an important one. To construct two runways of standard width and length involves nearly 100,000 square yards of paving and it is readily seen that the cost of the higher types of paving will run to large figures. It is well worth while, therefore, to consider those types that can be constructed at moderate expense. Second: The pavement structure should be one that can transmit the loads to a well drained sub-base. A covering of loose material without cementing qualities has no power to support or transmit a load to the soil and is only a temporary make-shift at best. Third: The pavement should have an even surface with no abrupt changes in grade. The heavy transport planes are moving at a high rate of speed at the point of take off or landing, and it is clear that the runway surface should present a reasonably true surface in order to facilitate this high speed movement with comfort and safety. Fourth: The pavement should be water-proof and have a roughened or non-skid surface texture. The importance of preventing water from penetrating any pavement is well known, and, if the runway be used for landing, it is very important to have a roughened surface. Transport planes land at a speed in excess of 50 miles per hour, and a smooth surface, covered with a thin film of water or frost, would present a hazard, in landing, that should be avoided. A roughened surface texture is, therefore, a safety factor of no small importance. Fifth: The pavement surface should be one that may be easily and economically repaired without delay to its use. Sixth: It should have good visibility from the air.

What are some of the fundamental principles to be considered in connection with the design of pavements for airports? It seems to be the impression of many that the design of a runway pavement presents the same problem as the design of a street or highway. There is, of course, a similarity in construction, in that the sub-base must be well drained and compacted;

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[1] Presented at the Thirteenth Annual Convention of the National Crushed Stone Association, Cincinnati, Ohio, January 22, 1930.

Methods of Constructing Bituminous Macadam Surfaces of Extra Smoothness[1]

By B. E. Gray,
Division Engineer, State Road Commission of West Virginia

ALL too frequently macadam roads have been built as if they were to be temporary surfaces; a wrong attitude to begin with. Any improvement to a state highway should be with the idea that stage construction is possible, and that as traffic increases, the surface may be strengthened and widened, utilizing all previous work. This means that even for low cost roads, careful attention should be given to alignment and grade, and with drainage structures properly placed to take care of future changes with minimum cost. There is no reason to slight work just because funds are limited; on the contrary, the best engineering talent should be employed to obtain maximum results from these limited expenditures.

As in every other phase of human endeavor, there is usually a reason for any particular set of conditions, and in the construction of macadam types, poor results come about largely because of too little insistence in the observance of fundamental principles, and the hope (if it may be so termed) that in some way a good surface would finally happen. It is all very well for a group of executives to get together and write a set of specifications for methods and materials. It is quite another, to go back home and build an organization of engineers and inspectors to carry them into practice, especially with the "feast or famine" condition that exists in public work. And yet it is upon the inspector that success or failure largely depends, and he must be sold on the need for doing work as planned, and imbued with a desire to obtain quality results; never satisfied with anything less.

Early Macadam Roads

Early macadam roads were built by laying either crushed or napped stone upon road beds which had been stabilized under horse-drawn traffic. The layer of stone was filled with screenings, and then water bound and rolled. Under iron tired traffic there was gradual wear so that additional dust was continually being worked into the voids, and over a period of years these surfaces became very firm and fairly smooth. Any serious variations were repaired by adding fine stone and additional screenings, and for the slow moving traffic, no particular need was felt for extremely even surfaces.

With the advent of the automobile, such surfaces deteriorated very rapidly, due to tire suction and consequent loss of filler. The first experiments with surface treatment brought widely varying results, but in general they were satisfactory, and adequate for motor vehicle speeds of not over 25 miles per hour. With the further growth of traffic, rapid extensions of roads were made. The old methods of construction were still followed, and on new road beds, much settlement occurred, until in many instances macadam types obtained a bad name because of roughness. No particular requirement was made as to checking sub-grade and base, it being generally thought that all irregularities could be taken out when the top-course was placed. It is needless to add that experience soon showed that such conclusions were erroneous, and resulting from the experience gained over the intervening years, state highway specifications have been written, which now take into account the absolute necessity of giving as close attention to every step in the construction of a macadam surface, as for the most costly pavement.

Present Methods in West Virginia

West Virginia specifications of 1929 call for subgrade to be prepared in accordance with profile, grade, and cross-section, with variations not to exceed ¼ in. in 10 ft. of length. Before placing any stone, the subgrade is to be thoroughly rolled, all weak or soft places to be stabilized with solid materials, and the entire area to be checked prior to placing any stone. Specifications for the stone call for a product of uniform quality, proper grading, and size. Extreme care is taken in placing base-course to see that uniform depth is obtained, and the surface is closely checked. Every care is then taken to see that the base-course is thoroughly filled with stone screenings and dust, in order that all voids shall be full and no movement in the base-course possible. It is preferable that new base-course shall be constructed one year, and top-course

[1] Presented at the Eighth Annual Asphalt Paving Conference, October 28, 1929, West Baden Springs, Ind.

laid the year following. There is a decided tendency to change the specifications and methods of construction so as to follow this plan.

Where the base-course is laid one year and then opened to traffic through the following winter, the surface should be treated with asphalt in two applications, the first consisting of ¼ gal. asphalt primer coat, which is readily absorbed and requires no cover, and the second application of ¼ gal. cold liquid asphalt applied several weeks afterward, and covered with approximately 20 lb. of chips. In no case should base-course be laid upon road beds graded the same year (unless absolutely necessary); as some settlement is bound to occur with resulting distortion of the surface.

While napped stone base of fair quality has been laid, yet in order to obtain really smooth riding surfaces this type should be discouraged and crushed stone used instead. As a further step in obtaining smooth surfaces, this crushed stone base should be built up in layers, each not to exceed 4 in. compacted depth. Specifying such a maximum depth insures thorough filling, and consequent less likelihood to move under traffic. To obtain results which will comply with these specifications throughout, requires most rigid inspection. The old methods of laying macadam pavement had become so well established that very few contractors appreciate this need for refinement, and failing to see the value of checking so closely, there is required constant supervision on the part of the inspector to see that proper results are obtained.

Equipment for Testing Smoothness

Somebody has said that "Genius consists of an infinite capacity for taking pains," and certainly the construction of macadam pavements of extra smoothness depends entirely upon such attention. To insure high quality, several additional types of equipment have been devised, and successfully used during the past season. The old time straight edge, of course, together with the template for obtaining proper cross-section, are used constantly on both sub-grade, base-course, and top. After surface treatment of the base-course, and prior to placing the top, an additional instrument has been tried, known as the "Grade-Rater." This is a wooden frame, approximately 10 ft. in length, with a small wheel at each end, and in the center a metal pointer which drags on the surface of the pavement, and indicates any variation (in fractions of an inch) on a scale at the top. The machine is operated with a pair of light plow handles, and the scale is readily visible to the operator. The method is to push the machine longitudinally with the road, and whenever the scale indicator shows a variation beyond the specification tolerance, a chalk mark is made indicating the high or low area. The "Grade-Rater" is run down and back twice on either side of the center so as to cover every 4 ft. interval of width. All areas which vary from the true surface are patched before placing the top-course. In making these patches, the greatest care should be taken to use a minimum amount of asphalt, in order that no change in texture may occur. It is essential that the base-course conform exactly to the desired cross-section and profile, if the final surface is to remain smooth.

The same care is taken in placing top-course; first, to obtain a uniform material with the densest possible grading, and then to follow the same procedure of checking for irregularities before the final seal coat. One of the most common faults in construction is the tendency to use too much bituminous material. If the surface appears to be somewhat irregular in color, dry, and with even a number of small pittings, there is nothing to worry about, as it can be easily corrected with the final seal coat. On the other hand, a surface which has a very black, totally flushed appearance, is quite apt to be too rich, and with the application of the seal coat corrugations result. Prior to the seal coat, the "Grade-Rater" is again run over the surface to check all variations from standard, and all low places are again patched, using the minimum possible amount of bitumen. It is during this process of checking, adjusting, and patching, that the greatest difficulty usually occurs with the contractor, and it is a time when the inspector needs to exercise all of his tact and patience, and yet at the same time to be persistent and insistent that his instructions are carried out.

It is desirable that several weeks to several months elapse before the seal coat is applied. This gives an opportunity for settlement and compaction of the top-course, and for all spongy, loose areas, to whip out under traffic, thus leaving a solid surface on which to apply the final application of bituminous material. This final application is ¼ to ⅜ gal. cold liquid asphalt, but which is heated to about 100° F. A sufficient amount of ¾ in. chips is applied to take up all surplus bitumen, and here again a new machine has been employed with satisfactory results. It is difficult (even with experienced operators) to apply chips from stock piles in an absolutely uniform manner. The several chip

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"THIS London City, with all its houses, palaces, steam-engines, cathedrals, and huge immeasurable traffic and tumult, what is it but a Thought, but millions of Thoughts made into One—a huge, immeasurable Spirit of a Thought, embodied in brick, in iron, smoke, dust, Palaces, Parliaments, Hackney Coaches, Katherine Docks, and the rest of it! Not a brick was made but some man had to *think* of the making of that brick."

These words of Thomas Carlyle are as true today as on the day they were written. Accomplishment is only the final action in a train of events initiated by some thought. Nothing worth while is possible which is not based on thought. Someone gets an idea; he acts and with much hard thinking he accomplishes his purpose. But first and of the utmost importance is the original conception. Without that he could not have been started into action. Without subsequent straight thinking he could not have been successful in his accomplishment.

Where do thoughts originate? That is a philisophical question which is at least debatable but this much is certain. Knowledge gained by study, by discourse with one's fellowman to discover how he is thinking, inevitably leads to the stimulation of thought and the ultimate accomplishment of things worth while. That is why conventions of trade associations are of such value to those who attend them.

By personal contact with some one in the same business who has had experience, thoughts are gained which are of very great importance. Perhaps a mere hint is given which germinates into an idea leading to a plan of proper action. Many a crushed stone producer must have had just these experiences at the annual conventions of the National Crushed Stone Association. Certainly many have been inspired by the stimulating thoughts they have received and fully as many have carried away with them information which they have used in their business affairs, whether their duties lay in administration, operation or sales.

If no further good resulted from our annual foregatherings than the stimulation and inspiration of thought, these gatherings would still be of inestimable value. Conventions stimulate thoughts which lead to accomplishment.

Committee Membership

ONE of the most effective methods for accomplishing real progress in organization work is through the medium of committees. Perhaps the most striking example of such procedure is found in the Congressional Committees, without which it would indeed be difficult for the Congress to function efficiently and effectively.

This is equally true of trade association work and specifically of the National Crushed Stone Association as there probably exists no better means for solving the complex and intricate problems confronting the crushed stone industry than through the active and helpful cooperation of committees specifically assigned to definite problems. The success of such a procedure, however, is necessarily premised on the supposition that the committees will actively and vigorously undertake the work assigned to them. When such is not the case, the committee becomes more of a hindrance than a help as in addition to not accomplishing the task assigned, it more often than not prevents others, through fear of encroachment, from undertaking work which they might otherwise do.

Appointment to a committee should not be accepted lightly, nor should it be refused without careful and deliberate consideration. Committee appointments are not offered before giving due consideration to the peculiar fitness of the appointee to assist the committee in the discharge of its work. Acceptance carries with it not only the honor but the responsibility and solemn duty of performing to the best of one's ability the task assigned. This cannot be done in most instances without real personal sacrifice. Neither can the work of the Association be advanced without the helpful assistance of its membership and no better way exists for manifesting the desire to help than by accepting committee appointments with the full realization of what such acceptance implies.

The organization of committees for the carrying on of the work of the Association during the present year is now under way. When offered an appointment, do not lightly refuse and when accepting do so with the full knowledge of the responsibility entailed and with a keen and earnest desire to do your utmost, even though frequently inconvenient and at real personal sacrifice, to assist in the work of the committee to which you are appointed.

It is only upon such a basis that the Association through its committee work can make real progress during the present year.

Accident Prevention

AT the recent convention of the crushed stone industry held at Cincinnati, a portion of one session was devoted entirely to a discussion of problems in accident prevention. At that time also, there was formally presented the Explosives Engineer Award which is given to the member of the Association enrolled in the National Safety Competition which each year obtains the best accident prevention record.

Attendance at this accident prevention session could not help but impress one with the gratifying conviction that the crushed stone industry is taking more and more seriously the matter of making our quarries safer places in which to work. Nor has the energy expended in promoting accident prevention been without direct and tangible results as can be quickly appreciated, when it is considered that during the first year (1926) of the National Crushed Stone Association Safety Contest two quarries completed the year with no lost-time accidents; during 1927 three quarries made perfect records; and in 1928, the last year for which figures are available, five quarries found it possible to complete the year with no accidents. More amazing still is the fact that one quarry has maintained a perfect record for over four successive years. Can it be that we still hear, though less audibly than a few years ago, the wiseacres saying, "Accidents cannot be prevented!" It is possible that in some isolated instances such an opinion is still held, but the encouraging thing is that for the industry as a whole we seem to have seen the light and appreciate that by earnest, serious and concentrated effort, intelligently directed, accomplishment little short of the miraculous is possible in the field of accident prevention.

A contributing factor which has materially aided the industry in becoming safety conscious, has been through safety contests.

Such contests definitely fulfill two functions:

First, they arouse in the individual a competitive spirit, a desire to excel which is an inherent characteristic of human nature and when applied to accident prevention assists materially in focusing the attention of the individual on performing his routine duties with more regard not only for his own personal welfare but for that of his fellow workers as well; second, participation in a safety contest makes it necessary for accurate records to be kept on all accidents and it takes but a short while to accumulate in this way accident prevention statistics of inestimable value.

The crushed stone industry is particularly fortunate in having the United States Bureau of Mines act as the collecting and analyzing agency for accident statistics for the industry. Some few years ago there was instituted by *The Explosives Engineer*, the National Safety Competition, one class of which includes the production of crushed stone. Later, because of a desire to encourage accident prevention specifically among crushed stone producers, *The Explosives Engineer* offered an award for the member of the National Crushed Stone Association entered in the National Safety Competition who each year made the best accident prevention record.

Every member of the Association, if he has not already done so, should immediately enroll in the competition for 1930. Application blanks can be obtained by writing to the United States Bureau of Mines, at Washington, D. C. The accident prevention movement deserves your enthusiastic and earnest support. You can cooperate in no better way than by participating in the contest and thus assist the industry in collecting accurate and comprehensive statutes relative to this important phase of our work. Act now by immediately advising the Bureau of Mines of your intention to enter the contest.

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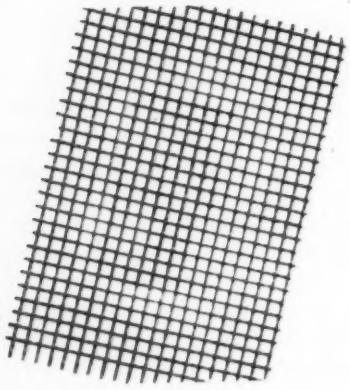

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Accident Prevention in the Crushed Stone Industry

(*Continued from page* 10)

should suffer a loss of pay through any condition disclosed by such periodical examinations.

Obviously, first aid should never be neglected. If every injury, no matter how trivial, is promptly and properly treated, infections and fake claims will be eliminated. Besides this, if the first aid equipment and practice are inadequate or poor, it will be hard to convince the men that the management is sincere in its accident prevention work. Herein often lies the chief value in the work of first aid and resuscitation teams. Every one should know how to give first aid and how to resuscitate a person unsconscious from electric shock, drowning or gas, but on the average, few will ever have occasion to use such knowledge. But the teaching of it and competitive demonstrations aids greatly in arousing and maintaining interest in safety work generally.

The Question of Insurance

There has been much complaint of insurance rates. But insurance rates merely reflect the experience of the industry as a whole. The underwriters want to keep rates as low as possible because unnecessarily high rates lessen the volume of business. On the other hand, losses incurred through setting rates too low are extremely hard to recoup.

An ideal rating situation would vary the rate for each individual establishment in accordance with its record of casualties. In actual practice, it is extremely difficult to do this, however, because the expense of such accurate rating would eat up all possible profits, since usually most quarries are small. In other words, to rate the average quarry in advance with any degree of accuracy would require very careful analysis on the ground by highly experienced men and no ordinary insurance premium would bear the cost. The insurance companies are working toward selective rating and the recognition of good accident prevention work by the individual organization, but it is still not possible to get good accident prevention work translated promptly or wholly into insurance rate. There must always be a very considerable gap between the two. Insurance is necessarily based on averages.

Self-insurance may, particularly with the larger organizations, be decidedly profitable. It should never be undertaken without writing some form of a stop loss policy to take care of catastrophic hazards. Also, it should never be undertaken except in connection with an energetic sustained policy of prevention. Self-

insurance can be profitable only when the accident rate is well below that of the industry as a whole. If a management is inclined to be half hearted in its efforts to eliminate accidents, it had better not self-insure.

Self-insurance is sometimes urged by the safety engineer because it brings home to the management both the profits possible from accident reduction and the cost of a high accident rate. With insurance there is a tendency for the insured to feel that the loss is not his, and also that there is little to gain by reducing accidents since it is so difficult for him to get his rate reduced. But with self-insurance, every cost is a direct cost, and accident prevention will be more certain to receive a proper share of executive attention.

Carbon Limestone Company Moves Headquarters

We have recently been advised of the removal of the headquarters of the Carbon Limestone Company to 1504-7 Central Savings Tower, Youngstown, Ohio. The correspondents of this company are urged to address their communications to the new location.

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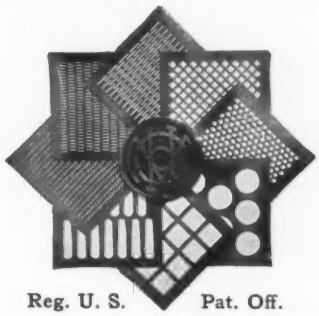

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Methods of Constructing Bituminous Macadam Surfaces of Extra Smoothness

(*Continued from page* 13)

spreaders (which have been used) also produce results that vary considerably between the beginning and the ending of the load. To overcome this difficulty, the following instrument has been devised. It consists of a triangular frame made of steel, supported on wheels at each corner, with a cross member to which is attached a 10 ft. length of wire brooms. This cross member may be moved vertically to obtain any desired pressure of the brooms on the surface. It is operated immediately after the application of chips, producing a uniform distribution over the surface, thus overcoming any tendency to bunching. While at first thought it would appear to be of minor importance, yet it contributes that extra refinement which results in a perfect surface.

Construction Methods on U. S. Route 50

To substantiate the conclusions set forth above, an experiment in construction was made during the past summer on U. S. route 50 crossing the Allegheny Mountains. The section is 10 miles in length, the roadway having been previously graded and all drainage structures installed during 1923-24. Through the intervening years, constant maintenance has been carried on, so as to produce an entirely stable, graded earth road. Contracts were let for this 10 mile section, divided in two 5 mile parts, one being for crushed stone base. Work proceeded simultaneously on the two sections, and they were completed nearly at the same time. The grade was so laid as to require trenching from one end of the job to the other, thus putting the sub-grade in thoroughly compacted material; maintaining the full roadway width, and in addition providing a surplus of berm material so that no disfiguring robbing of the slopes was necessary. The precautions set forth above, such as checking sub-grade, stabilizing weak spots, placing the base-course with carefully graded, uniform material, insistence upon thorough filling and rolling, checking with straight edge and template to the specification tolerance, were all carried out. Just prior to the completion of the base, a single contract was let for the full 10 mile length of top-course, the type being "puddle macadam," 3 in. compacted thickness, 18-ft. in width, and with a 2 in. crown.

This surface was laid under traffic, full width, with only a temporary barricade during the few minutes required to pour the first application of one gallon per square yard. The method of constructing "puddle macadam" has been previously described in a paper before the Highway Research Board, December, 1927. An experiment was made this summer, however, using asphalt primer coat for the initial application. It had been thought previously that insufficient penetration would be obtained using this material, but on the contrary a penetration of 1½ in. was had within two hours after application. Practically no cover coat was required, other than just enough to prevent picking up of the surface. Rolling was delayed for about an hour after application, and then made once over to obtain initial compaction. Rolling continued at intervals of several days thereafter, as the asphalt residue hardened, to keep the surface in shape. The results were very satisfactory, and this material will be specified for future work. The pavement was laid at the rate of about 1500 lin. ft. per day, and all of the precautions for testing the surface were carried out as above noted, the inspector being an unusually persistent individual, and contrary to the recommendation of one of our great industrial leaders, a man of about 60 years of age. He was on the job at 7.00 A. M., and did not leave until after the contractor at night, a quality not always found with some of our younger college graduates. Traffic used this surface for several months prior to the seal coat, and while very little asphalt had flushed the surface, and a certain amount of shallow pitting occurred, this was not at all harmful. The final seal coat consisted of ⅜ gal. cold liquid asphalt, heated to maximum fluid condition, covered with approximately 20 lb. of chips, and dragged with the steel broom as outlined above.

Shortly after this contract was finished, the remaining gap on U. S. 50 in Maryland was also completed, and immediately thereafter a large increase in traffic took place, so that an excellent opportunity has been had during the past two months to determine the riding qualities of the macadam section after being subjected to concentrated high speed traffic.

Test of Surface Smoothness

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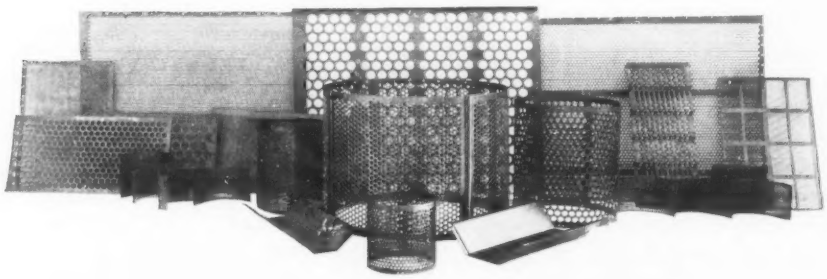

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CROSS ENGINEERING CO.

CARBONDALE, PA.

they are changing in their riding qualities. Previously built macadam with good smooth riding surfaces have had an index of 100 to 150. Good riding concrete built in previous years has run between 75 and 125. These are pavements that two or three years ago were considered of good quality in smoothness and easy riding. The index for the ten miles constructed with the methods outlined above is between 50 and 60 for the crushed stone base section, and from 55 to 65 for the knapped stone base. Even with every precaution, it is not possible to obtain the same smoothness with knapped stone, and it is probable that any deterioration in riding qualities will be more marked for the knapped stone than for the other. The index is arrived at from the amount of spring deflection over a mile of road at 25 miles per hour, so that the lower the index, the smoother the surface. Hundreds of miles of road have been checked with this instrument under all conditions of weather and temperature, so that good calibration is had, and while the results are not absolute, yet their comparative values are certain. Car speeds on this 10-mile stretch have run as high as 60 to 80 miles per hour on tangents, and while such speeds are by no means encouraged, yet the public derives a certain satisfaction in having pavements on which they can drive fast if desired. The many compliments received on this road further proves that the public is not so much interested in the type of road, as they are in its smooth riding characteristics, and that if a state desires to continue the use of the so-called cheaper types, then all they have to do is to use the same care and preparation as for the more expensive surfaces. The cost of good inspection is much less than poor inspection, for the saving is immediately reflected during the subsequent years, in lower maintenance charges, and the satisfaction derived from the excellence of the road.

The same principles apply to the construction of gravel, "retread," or even asphalt treated shales. It pays to take pains with the smallest details. If by following these methods, excellent durable surfaces can be obtained at costs from $5,000 to $20,000 per mile, and then maintained thereafter at an annual expense which is less than the difference of interest charges on these types and the expensive pavements, assuredly there will be much approbation from the public because of the much larger mileage from the same expenditure of funds. I repeat; the public does not care what the road is made of, but it does demand (and properly so) that those roads shall be smooth, and safe.

Airport Paving

(*Continued from page* 11)

a foundation course installed and a surfacing of some kind laid. But when we consider the use to which the two pavements are subjected the similarity ceases.

The traffic on a highway is confined to narrow lanes. That is, cars follow each other in the same narrow path. A runway pavement must, of necessity, be much wider than a highway, five or six times as wide in fact, and if one observes a number of planes taking off or landing in succession, he will notice that no two of them use the same path. Where traffic on a runway spreads out over a wide area, on a highway it is concentrated.

The volume of movement on a runway can never reach that of a highway because only one plane can safely use it at a time. Then again there is great difference between the movement of a car on a road and a plane on a runway. The car is propelled by the grip or thrust of the tires on the pavement. The plane is pulled along by the propellors, the tires merely rolling over the surface.

The effect of impact caused by a truck moving over a paved surface has been demonstrated from experiments carried on by the Bureau of Public Roads. No experiments have been made to determine the impact from a landing plane or one moving along a runway, but it must be relatively less than from a truck, because of the shock absorbers on all heavy planes and from the fact that the wings of a plane support part of the load.

When a plane starts to take off, the total weight rests on the pavement, but as it moves down the runway and the speed increases, more and more of the weight is supported by the wings, until finally at the instant of take off there is no part of the load on the pavement at all. In landing the process is reversed. The instant before the plane touches the runway, its entire weight is supported by the wings. At the point of landing a part of the load is transmitted to the pavement. As the speed diminishes, more and more of the weight is supported by the pavement until finally the speed is slackened to such a rate that the wings have no carrying power and the weight of the plane is all carried by the pavement. With a truck moving over a pavement, the impact increases with the speed, while with a plane the impact decreases with the speed. I am of the opinion that the effect of impact from landing planes is much less than has been generally assumed, but there is need of experiments to furnish definite data on this subject.

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I have gone into this subject in some detail in order to show why, under favorable conditions, pavements of very moderate cost are being used with a success for runways. There are locations that require a strong type of pavement structure, but if the soil is easily and readily drained a crushed stone or macadam base may be entirely satisfactory. On some soils an asphaltic concrete base may be the answer. If the drainage conditions are bad or uncertain, it may be best to use a Portland cement concrete base.

Some form of asphaltic surface, if properly designed, will be found very satisfactory and economical to construct regardless of the base used. It has a resilience not found in other types of surfaces, and its ability to withstand impact without damage, is well known. It can be laid easily and quickly and put into service almost immediately. If light repairs are needed they can be made with very little interruption in the use of the pavement. If a general surface treatment is required the work can be done with a minimum of interference with the operation of the runway. An asphalt surface may be given any degree of rough texture desired, and another favorable characteristic is that it is dustless.

Very few airports in the world have been equipped with paved runways. In Europe the practice has been to provide a strong turf and to pave around hangars only. There are some authorities in the United States who do not advocate paved runways, but prefer an all over field of turf. There is no question but what a field covered with turf will give satisfactory service during favorable weather, but there are certain times when the weather conditions are such that planes can not be operated from such fields. We have just experienced such a condition. During the first two weeks of this year, many airports throughout the country were so water-soaked as to absolutely prevent their use. At such times runways are absolutely necessary, if the field is to be operated.

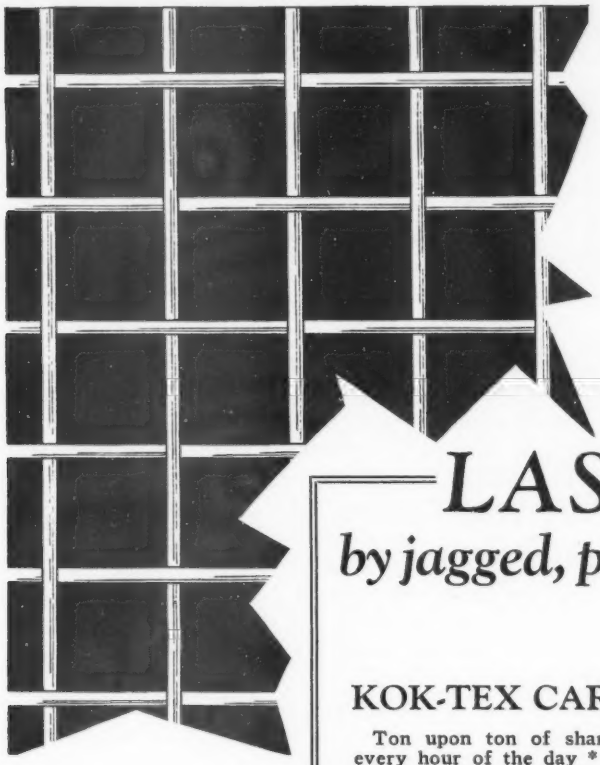
In the United States, cinders treated with asphalt, have been used at a number of ports as an economical way of taking care of a bad situation, but the economy of such construction has yet to be proven. A cementing gravel has been used on one or two fields, but without some surface covering they will become dusty in dry and muddy in wet weather. In certain sections of the Western States an economical surface has been secured by treating the sandy soil with oil. Experiments have also been made recently at St. Louis with a mixture of oil and earth. This is quite a departure from proven paving practice and will be watched with interest.

The first hard suface runway was constructed of concrete at the Ford airport at Dearborn, Michigan. At the Grand Central airport at Los Angeles, one of the few fully equipped ports in the United States, there is a take-off strip of Portland cement concrete, and a landing area of oil treated sand. Runways of sheet asphalt laid on an asphalt concrete base have just been completed at Detroit. Asphalt concrete has been used for paving around hangars on several fields in the West and has proven satisfactory.

At Port Columbus, the municipal field at Columbus, Ohio, it was decided to provide a field with turf, but to also construct two runways in order that operation at all times would be assured. This port has been in operation for six months, and our experience has demonstrated the necessity for runways if 100% operation is desired. There has not been an hour of any day since this port has been in operation that the field was not available for use. The runways at Port Columbus are 100 feet wide, one being 3500 and the other 2500 feet long. The construction consisted of a one and one-half asphalt concrete surface laid on a Portland cement concrete base. The base was of standard specifications with the thickness reduced to 5 inches. The asphalt surface mixture averaged as follows:

Bitumen	6%
Mineral Dust	6%
Sand	28%
¾" Limestone	60%

This gave us a dense mixture but with a roughened surface texture. The bitumen was asphalt from Mexican oils; the sand from Lake Erie; and the mineral dust and stone from local limestone quarries. In a longitudinal direction the pavement was laid to a grade that would fit the ground as closely as possible. This grade was very flat and surface drainage was secured by providing a cross slope of six inches in the 100-foot width. The water is caught in a gravel filled trench at the edge of the runway and carried away through a tile laid at the bottom. Coarse limestone was deposited along the edges of the runways at the top of these trenches to facilitate the quick removal of water, and to provide a material that would not pick up by moving planes. This 3-foot strip of white stone at the edge of the runways also adds to the visibility of the runway from the air.



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» CHIPS «

The chief engineer and the master mechanic had spent the evening together. For obvious reasons, the M.M. was a little hesitant about going home.

"I'll tell you what to do if you don't want to disturb your wife," said the chief.

"When you get in the house, undress at the foot of the stairs, fold your clothes neatly, then creep quietly up the steps to your own room."

They met the next morning at the plant. "How did you get on," asked the chief.

"Rotten," replied the M.M. "I did just as you told me. I undressed at the foot of the stairs. I folded my clothes neatly. I crept quietly up the steps. But when I reached the top—it was the elevated station!"

—*The Fire Box.*

Why Advertising Managers Go Mad

When the proofreader nods, the results are sometimes disastrous. Hence, when a department store ran an advertisement like this, there was weeping, wailing, etc.:

"Men's athletic union suits, tomorrow, 95 cents. Brightly colored cretonne. Tie-back style. Ruffled edges. You can't imagine how dainty these will look hanging at your windows. An expert will call at your home to take measurements. Fast colors. Need little laundering. Hurry! They can't last long."—in the laundry either.—*The Ad Pointer.*

Oh! Oh!

"Really, I can't play golf," the sweet young thing said. "I don't even know how to hold the caddy."

—*Drexerd.*

"You can take your finger off that leak in the pipe now, Father."

"Thank heavens! Is the plumber here at last?"

"No—the house is on fire."—*Exchange.*

CHINESE PATIENT (over telephone): "Doc, what time you fixee teeth for me?"

DOCTOR: "Two-thirty, all right?"

CHINESE PATIENT: "Yes, tooth hurty me all right, but what time you want me to come?"—*Oral Hygiene.*

Raising the Ante

The captain of a small trading vessel wanted to land some contraband at a certain port. Approaching the customs officer, he said: "Joe, if I put a ten-shilling note over each eye, could ye see?"

"I could not," said Joe. "And if I had one in me mouth I couldn't speak."—*Weekly Scotsman.*

Pass the Bait

Vicar: "And what parable do you like best, my son?"

Boy: "The one about the multitude that loafs and fishes."—*Montreal Star.*

Ready with an Answer

Pat was hired in a lumber office. The proprietor was a young man and he decided to have some fun with the new hand, so Pat was left in charge of the office, with instructions to take all orders which might come in. Going to a nearby store, the proprietor called up the office:

"Hello! Is this the East Side Lumber Company?"

"Yes, Sorr."

"Send me up one thousand knot holes."

"What's that?"

"One thousand knot holes."

"Well, now an' ain't that a shame! We are just out of them. Sold them all to the brewery."

"To the brewery? What do they want with them?"

"They use them for bungholes in barrels."

Poor Engineering

"Why all the bandages on Jones' head?"

"Rotten bridge."

"Break through?"

"No, trumped his wife's ace."—*Exchange.*

Judge: "Married or single?"

Witness: "Married."

Judge: "Where were you married?"

Witness: "I don't know."

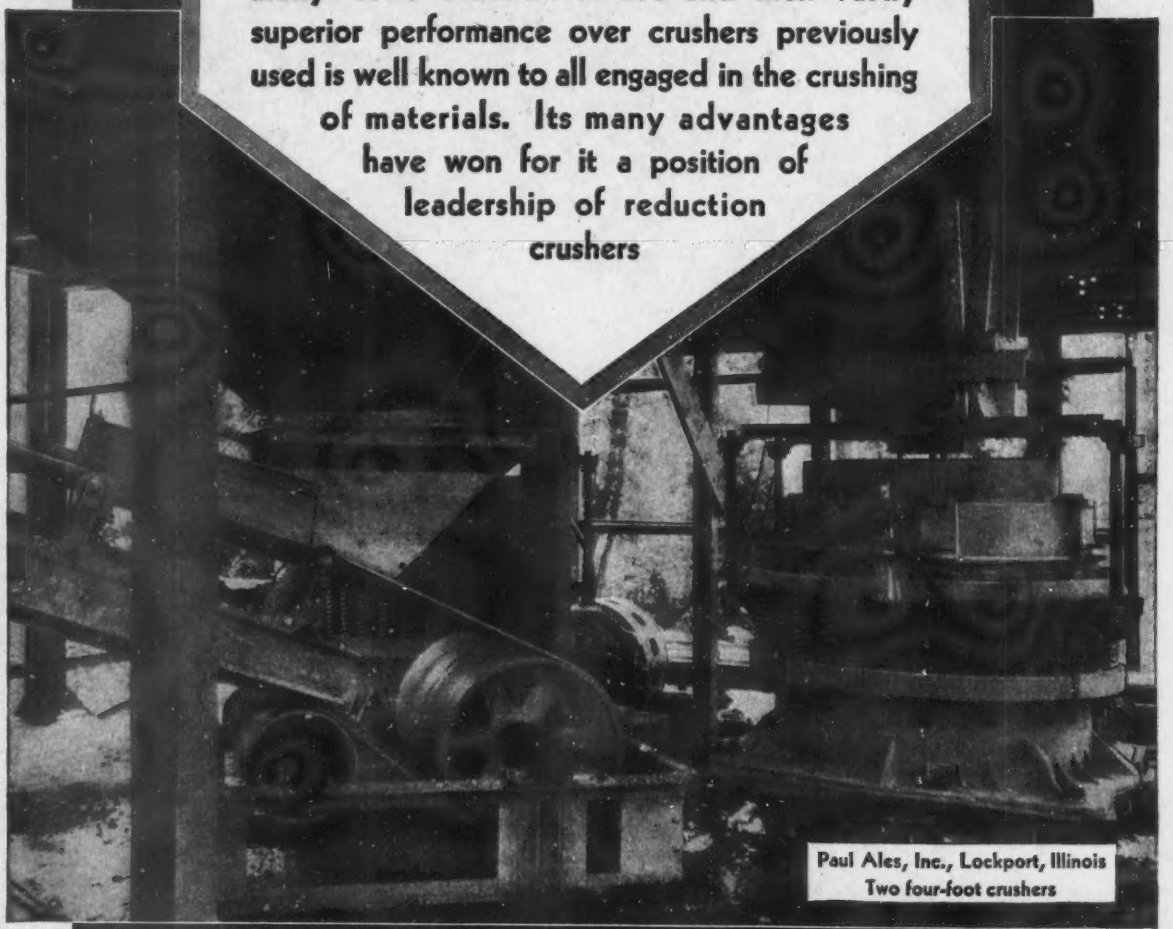
Judge: "You don't know where you were married?"

Witness: "Pardon me, I thought you asked me why I married."—*Exchange.*

SYMONS CONE CRUSHER

A Contribution to the Crushing Industry

The introduction of the Symons Cone Crusher marked a new era in reducing crushing, in fact it is the only advance made in crushing equipment in recent years. Its development was built around a new idea, a radical departure from any previous design or construction. The many Cone Crushers in use and their vastly superior performance over crushers previously used is well known to all engaged in the crushing of materials. Its many advantages have won for it a position of leadership of reduction crushers



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What Practical Quarry Men Think of Cordeau-Bickford

From time to time expressions of opinion regarding CORDEAU-BICKFORD come in from the trade and comments are made in articles. Some quotations from such sources are as follows:

"We prefer CORDEAU as it is safer and the chances of misfire are practically nil."

"We use considerable of your product every year and results obtained are entirely satisfactory."

"We have been using CORDEAU-BICKFORD for a number of years and are glad to state that our experience with it has been very satisfactory and believe that it results in reducing our cost of blasting."

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